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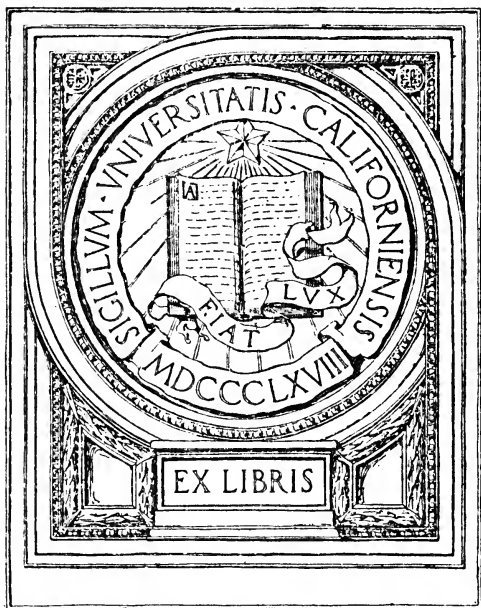
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EXCHANGE



# VARIATION IN ACHIEVEMENT AND ABILITY WITHIN THE GRADES

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JUN 14 1933

BY  
S. C. GARRISON, PH.D.

GEORGE PEABODY COLLEGE FOR TEACHERS  
CONTRIBUTION TO EDUCATION  
NUMBER EIGHT

No. 8



PUBLISHED UNDER THE DIRECTION OF  
GEORGE PEABODY COLLEGE FOR TEACHERS  
NASHVILLE, TENN.

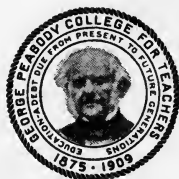
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## PART I

### 1. INTRODUCTION\*

During the past few years much psychological investigation has been made into the nature and amount of individual differences. Before the publication in 1883 of Galton's "Inquiries into the Human Faculties and Its Development," the work done had been only of a general nature. Up to that time psychological conceptions had been based largely upon data secured from investigations made upon the mental processes by which we know and recognize the physical world.

Since that time much has been done in the standardization of tests for the measurement of mental and physical abilities. Also a large number of scales have been developed by means of which the problems arising in education are studied. Methods of applying these standardized tests and of handling the results secured in a scientific way have been developed. This whole field of endeavor is but a part of a much larger one which has during the last century been extending and applying science to all phases of life.

Ever since Galton announced the results of his investigations, this field has been a fruitful source of experimentation. A number of investigations have been made simply for their scientific interests. Others have been made with a view of discovering the causes for certain social and moral conditions. And yet others have been undertaken in which the work was confined principally to school children, with the hope that the results might aid in solving some of the pressing educational problems. These studies have been confined for the most part to children in the upper grades, or to college students, and a major portion of the work devoted to younger children has dealt with physical rather than mental abilities. Probably the most fruitful work in the field of individual difference for the educator interested in children in the lower grades has come as a by-product of investigations aimed primarily along other lines. Just now much work is being done with educational tests. Variations in the achievement of pupils, and even classes and schools, are being measured.

The studies on the question of mental ability and its relation to school work have been very fragmentary. The bright school child has been neglected by most investigators. Perhaps one reason for this lies in the fact that many

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\*This study was made during the school year of 1917-1918. Its completion was delayed by the World War.

studies have been made by those not directly interested in school work. A very large number of investigations have been made with reference to the relations existing between low mentality and the social vices. This question has been a very pressing one, and it is but natural that new methods of investigation should first be applied where apparently the need is greatest.

It is important that the school know the individual differences and possibilities of the children it is trying to educate; it should know what abilities exist and how they are distributed; it should know how many dull, normal, and bright children there are, how they are distributed, and where each child ranks on a definite scale of values. It is extremely important that no social or educational hindrances be permitted to handicap the development of children of unusual ability.

Perhaps the most frequent criticism of the ordinary grammar school is that it subjects all pupils to the same conditions. Only in a few schools is provision made for superior ability. Pupils of different abilities are subjected to the same conditions. They take the same course of study for the same period of time and are promoted together. Even the time of promotion is fixed beforehand without any regard to the differences in ability represented in the grade.

## 2. THE PROBLEM

This investigation has been undertaken with a view to obtaining facts on educational questions which arise because of individual differences in the ability of grammar-school children. It is an attempt to help solve some of the everyday educational problems which arise because of individual differences in pupils. We wish to study the difference in the various abilities of children, some of whom stand at the top of the class and others at the bottom. Are the children at the head of the class stronger in some special ability than those at the bottom? In what abilities are the children at the bottom of the class weakest? Where is there greater variability with reference to mental ability—at the top or the bottom of the class? What relation is there between mental ability and standing in the grades? These are some of the questions we wish to hold in mind throughout the study. It is hoped that the study will contribute something to method, in that we will be better able to judge the abilities of the various groups within the grades. It is hoped also that the study will contribute something to school organization, inasmuch as we will notice the overlapping of mental ability.

## 3. THE SUBJECTS

The subjects used in this investigation were the children of the fourth, fifth, sixth, and seventh grades of the Peabody Demonstration School. Only those children who had been in the school for a year or more and who had been fairly regular in attendance were used. No attempt was made to select the children because of class standing. The only factors used in the selection, as stated above, were regularity of attendance and enrollment in the school for at least a year before the study was made. As a matter of fact, most of the children taking the tests had been attending the school three years. In all, 108 children—43 boys and 65 girls—were used. These were divided between the four grades, as follows: fourth, 24; fifth, 24; sixth, 30; and seventh, 30. They were divided according to sex as follows: fourth, 10 boys and 14 girls; fifth, 8 boys and 16 girls; sixth, 14 boys and 16 girls; and seventh, 11 boys and 19 girls. Tables Ia to Ic show the distribution of the children used in the study according to age, sex, group (each group contains approximately one-fourth of the grade), and grade. Age has been considered here as meaning the age of the child at his last birthday.

TABLE Ia

DISTRIBUTION OF CHILDREN BY GRADES, AGES, AND SEXES

Age	Gr. IV	Boys				IV	Girls				G. T.
		V	VI	VII	T.		V	VI	VII	T.	
9 to 10	3	2	0	0	5	9	1	0	0	10	15
10 to 11	6	0	2	0	8	3	6	0	0	9	17
11 to 12	1	3	3	1	8	2	7	4	1	14	22
12 to 13	0	3	8	3	14	0	1	12	5	18	32
13 to 14	0	0	1	4	5	0	1	0	9	10	15
14 to 15	0	0	0	3	3	0	0	0	4	4	7
Grand total	10	8	14	11	43	14	16	16	19	65	108

TABLE Ib

DISTRIBUTION OF CHILDREN BY GRADES, GROUPS, AND SEXES

Grade	Boys					Girls					G. T.
	G. 1	G. 2	G. 3	G. 4	T.	G. 1	G. 2	G. 3	G. 4	T.	
IV	3	2	2	3	10	3	4	4	3	14	24
V	2	2	2	2	8	4	4	4	4	16	24
VI	3	4	4	3	14	4	4	4	4	16	30
VII	1	4	2	4	11	6	4	6	3	19	30
Grand total	9	12	10	12	43	17	16	18	14	65	108

TABLE Ic

AVERAGE AGE AND VARIABILITY OF EACH GRADE

Grade	Boys			Girls			WHOLE G.		
	Yrs.	Av. Mos.	A. D. Mos.	Yrs.	Av. Mos.	A. D. Mos.	Yrs.	Av. Mos.	A. D. Mos.
IV	10	4	7	9	11	5.6	10	1	6.0
V	11	2	11	11	1	9	11	1.3	9.7
VI	12	0.6	8	12	3	4.8	12	1.8	6.3
VII	13	3	8.7	13	2	7.5	13	2.6	8

TABLE Id  
AVERAGE AGE OF EACH GROUP

Grade	G. 1		G. 2		G. 3		G. 4	
	Yrs.	Mos.	Yrs.	Mos.	Yrs.	Mos.	Yrs.	Mos.
IV -----	10	7	10		9	9	9	9
V -----	11		10	7	11	8	11	6
VI -----	12	5	12	2	12	3	11	8
VII -----	13		13	2	13	8	13	

#### 4. THE FIELD

The field chosen for this study was the Peabody Demonstration School. This school is run in connection with George Peabody College for Teachers, and was under the direct supervision of Dr. Thomas Alexander, Professor of Elementary Education. The course of study covers the usual course found in the South. It, however, includes much more than is usually found in a twelve-grade course of study. Only the fourth, fifth, sixth, and seventh grades were used in this study.

The school draws its pupils from the best homes in the city. Its population is largely American. The homes from which the children come would compare favorably in wealth, social status, and intelligence with those of any city. The positions held by the fathers of the children are of a very varied nature. The following professions are the most frequent ones: banker, broker, city and state official, lawyer, manufacturer, and minister.

The fact that the school is dependent upon the tuition received from the pupils guarantees the hearty coöperation of its patrons. This fact will also attest to the character of the work of the school. Parents do not withdraw their children from public schools where tuition is free and where a good social atmosphere is prevalent to place them in a private school where there is a tuition fee, unless they feel that there is a distinct advantage in doing so. Furthermore, the school always has a very large waiting list. Parents make application for the enrollment of their children months ahead. Owing to limited facilities, only about 350 children can be provided for.

In a sense, the school receives only pupils from a select group. However, a close examination will reveal the fact that this selection is not from one class of pupils, but from all the classes usually found in a large number of children. First, there are those parents who feel that their children are able to do exceptional work, and want to give them the very best advantages possible. Second, there are those who know that their children are not progressing in the public schools as they should and who desire to place them where they will be given special attention by well-trained teachers.

Then there is a third group who send their children to a private school simply because they are able to do so.

At no time are the grades in the school overcrowded. There are simply as many pupils as there are sittings in each room; and there is one teacher for every grade, except in the upper grades, where the work is on the departmental plan. Specialists teach swimming, sewing, music, and manual training. All recesses are taken on the playground every day in the year, except in rain or snow. The children have access to the college campus and gymnasium. There is nothing fixed or formal about promotions, except that the pupil must prove his ability to go ahead. A spirit of coöperation between parent and teacher such as is seldom seen is prevalent in the school work.

## 5. THE TESTS

*A. Educational.*—The first group of tests consisted of a number of educational tests. These tests were used in a survey of the Peabody Demonstration School during the spring of 1917. A part of the data secured in that survey has been used in this study. The children were promoted at the end of the session, and the grade to which they were promoted has been used throughout this study as their school grade. The tests employed in that survey, the data of which have been included here, consisted of two arithmetic tests, two reading tests, one writing test, and one spelling test. Two of the tests—one of arithmetic and one of reading—were given again in the spring of 1918. It was originally intended that all the tests should be given again in the spring of 1918, and the study based upon a comparison of the two sets of data. Owing to the fact that the writer entered the United States Army, this was not found possible. No detailed description of the tests has been given here. This may be found in the case of any of the tests by referring to the bibliography.

One of the arithmetic tests used was that devised by Woody ('16). This arithmetic scale consists of two series, A and B, each four in number—one each for addition, subtraction, multiplication, and division. The A series was used in this investigation. These scales were devised to measure achievement in the fundamentals of arithmetic, either of an individual, of a class, or of a whole school system. The Curtis ('14) arithmetic tests consist of a number of series subdivided into several forms. Form 2, Series B, was used in this study. This group of tests was devised by Curtis to provide a general measure of the four fundamental abilities in arithmetic.

The spelling scale used was the one devised by Ayers ('15) for measuring spelling ability throughout the grades. This consists of a series of lists of words, the words in any list being approximately equal in difficulty. Three lists were used with each grade. Lists L, O, and I were used with the fourth grade; L, O, and Q, with the fifth; O, S, and Q, with the sixth; and Q, S, and U, with the seventh. Thus there are always two lists by means of which any grade may be compared with another grade immediately above or below it.

For the reading tests the Thorndike ('14) and the Kansas Silent Reading Tests were used. The Thorndike Reading Test used was one of four which Thorndike proposed to work out for testing reading ability. It is really a test of the pupil's knowledge of words. The Kansas Silent Reading Test was devised by Kelly ('15) to measure both speed and accuracy in reading. His purpose in devising the test was to secure one which would measure the ability to read and follow directions.

The handwriting scale used was the one devised by Thorndike ('10) for measuring legibility and speed in handwriting.

**B. Mental.**—The mental tests used are not described in detail, because they can readily be found by turning to the proper reference. Practically all the tests have been used in other investigations. The series consisted of tests of memory, perception, association, and invention tests of a linguistic nature. The memory tests were divided into six groups—three of logical memory, two of rote memory for concrete words, two of rote memory for abstract words, four of rote memory for related words, four of rote memory for unrelated words, and two of rote memory for digits. The logical memory tests used were: (1) The Marble Statue, as in Whipple ('15); (2) The Man and His Wagon, as devised by Miss Margaret Hart and used by Strong ('16); and (3) The Boy and a Piece of Cake, as devised and used by Strong ('16).

Pyle's ('13) lists of concrete and abstract words were used. The following lists of words were selected for the memory for related word tests:

table	holly	winter	school
chair	bells	ice	teacher
rug	gifts	river	book
picture	toys	cold	desk
bed	candy	sled	pen
dresser	tree	skate	read
trunk	chimney	water	write
clock	sled	melt	spell
brush	merry	brook	ink
light	deer	flow	word

The following four lists of unrelated words were also used:

music	ship	tree	sick
water	cap	bed	long
shoe	mouse	never	white
paper	ring	green	run
goat	button	die	cloth
noise	chalk	turkey	arm
house	turkey	break	match
cloud	street	dog	stamp
knife	hand	moon	inch
flag	snail	watch	city

The memory-for-digits test consisted simply of groups of digits, Whipple's ('15) procedure being followed.

The perception tests were divided into two groups—(1) the A test and (2) the digit test—as devised by Woodworth and Wells ('11). Two tests were given in marking letters and four in marking digits. Trabue's ('16) completion test (numbers B, C, D, and E) was used as a part of the test for inventiveness. The word-building test as proposed by Whipple ('15) was used as the other. Pyle's ('13) four lists of words for the opposites test were used for that test.

## 6. PROCEDURE IN GIVING THE TESTS

The educational tests were each given on a different day, and all the grades took the test on the same day. No set time was used. The experimenter simply made arrangement with the principal and went from grade to grade giving the tests. Wherever it was possible for one grade to disclose useful information concerning the test to another grade, the test was so given that only grades having taken the test or not having taken it were together at recess. There were apparently no cases of cheating. The tests were not given to grades below the fourth. Pupils who were absent did not receive an opportunity to take the educational tests at a later time.

As a rule, the procedure used in giving the mental tests was the same as that used in giving the educational tests. The only objects sought in giving instructions were to keep conditions uniform and to have the children thoroughly understand what was expected of them. It was desired to keep the conditions under which the children took the tests as near like actual schoolroom conditions as possible. For that reason all the tests were given to the pupils at their desks. All the pupils in each grade were given the tests, because it was feared that idle pupils might disturb those working at the tests. However, only the papers of those having taken the educational tests were scored.

In a few cases where a pupil was absent when a test was given, the test was taken later. So far as the examiner could discern, the tests were taken in a spirit of eagerness and fairness.

### 7. SCORING THE RESULTS

The method adopted in scoring the results of the educational tests was in each case that set forth by those who had standardized the test. This rule was adhered to throughout. In scoring the results of a mental test, methods already in use, which seemed to be reliable, were used. In case of a mental test where no method had been generally adopted, the one used was that which seemed the fairest and which seemed to vary as little as possible from results secured by other methods of scoring.

### 8. SCHOLASTIC RECORDS

In order to compare the results secured from the tests with class standing in each school subject, all the grades in each subject for the school year 1916-17 were compiled. From these a ranking was made. In grading the pupils, the following letters were used by the teachers: E, G, F, U, and VP. E is given to pupils doing the best work, while VP denotes work which is unsatisfactory. Theoretically and in actual practice most of the pupils receive the marks G, F, and U. The pupils are so ranked and graded that over a long period of time the grades will fall in a normal surface of distribution. Since the letters have no definite values, the ordinary values attached to such school grades were substituted. Wherever a minus or plus sign was attached to a letter, this was taken into account. A ranking was made for each month's work, and from these rankings a combined ranking was made for the year. While the method of changing group grades to rankings for any one month would be very gross, it was thought that a fairly accurate ranking could be secured when a number of rankings based on a year's work were used.

### 9. METHOD OF STUDYING THE DATA

A. *Ranking the Pupils.*—The name of each pupil used in each grade was written on a slip of paper and several teachers asked to rank the child according to ability. The teachers were asked to rate them not alone on school work, but as they saw them in the home and on the playground as well. For the fourth and fifth grades, only two rankings were available; for the sixth and seventh grades, three rankings were used. In no case did any teacher know



where any child had been placed by another teacher until all the rankings were made. Every teacher who ranked the children had taught or was then teaching the grade. From these several rankings of each grade a combined ranking was made. In making the combined ranking, all the positions given each child were added and a new ranking made from these totals, the child with the least total being placed first and the one with the greatest last.

*B. The Groups.*—In making the study it was desired first of all to keep the conditions as they are actually found in school work. For that reason, instead of selecting three groups (one making most progress, one making average progress, and one making least progress) from the four grades combined, it was thought best to study the four grades themselves, making four groups within each grade. The children in each grade have been grouped according to the teachers' rankings. These groups have been designated as G. 1, G. 2, G. 3, and G. 4. G. 1 is the best 25% in each grade and G. 4 the poorest, according to the teachers' judgment. In studying these various groups, IV G. 1 has been used to designate the best group in the fourth grade. Similarly for the other groups. In case the number of children in any grade was not divisible by four, the extra children were placed in the G. 2 and G. 3 groups. This was the case in the sixth and seventh grades.

*C. The Measures Employed.*—It was the aim of the investigation to study the individual rather than the group wherever possible. For that reason, as many facts concerning each individual as space would permit have been included in the tables. Any child's score, or his standing, in any or all of the tests may readily be found. However, from the standpoint of time and space, it would be physically impossible to study each child thoroughly. It was, therefore, necessary to compare groups rather than individuals. In making these comparisons, several measures were employed. The average (Av.) was used as a measure of central tendency. The Pearson Coefficient of Variability

$\left[ \frac{A.D.}{Av.} \right]$  was used as a measure of variability. For determining the relationships of abilities, the coefficient of correlation derived from the method of differences in relative position or ranks  $\left[ r=1-\frac{6 \sum D^2}{n(n^2-1)} \right]$  has been used.

The percentage of one group reaching or surpassing a given point in another group, or a given point in a total array of the scores for the four grades, has been used for

showing the differences between groups in the same test. This gives a value easily found, and its meaning is clear. Thus the percentage of pupils in one group who equal or surpass the highest 25% of another group, or of all the groups combined, is frequently used.

As a measure of position or rank attained by a pupil, the percentile or quartile has been used. Thus the best 25% of the pupils in a grade is designated as the first quartile (G. 1) or as those above the 75 percentile. G. 1, G. 2, G. 3, and G. 4 each contain one-fourth of the children in a grade, ranked from best to poorest. In this study wherever the term "quartile" is used, it is meant to designate a certain group of children or scores made by that group. The term "percentile" is used to designate a point in a total array of scores. The 75 percentile is that point above which the best one-fourth of the class falls.

## PART II

### 1. THE DATA

The final scores in each of the tests are arranged in Tables II to V, inclusive. The original material is of such amount that it was deemed best not to try to reproduce it all here. This is on file in the Jessup Psychological Laboratory. The scores have been distributed in the tables by grades and groups. As the tables are presented, each grade is divided into four groups. Each of the groups comprises approximately one-fourth of the grade. The number given any pupil in the tables designates his position in the grade according to the judgment of the teachers rating him. Thus, pupil number one in the fourth grade was rated by the teachers of that grade as the best pupil in that grade. By this method of distribution we are able to determine as far as our data permit the attainment for the best fourth (G. 1) of each grade, the next best fourth (G. 2), and so on. The sex of any pupil may be determined by reference to the tables. The age of each pupil is given with the final scores.

The data are presented in tables, then, so as to show: (1) the complete results of each test; (2) the final score given any child in any test; and (3) the rating, from best to poorest, given the pupils by the teachers.

## 2. FINAL SCORES

TABLE II  
FOURTH GRADE (IV)

			EDUCATIONAL TESTS				MENTAL TESTS									
No. of Pupil	Ages		1Curtis A.	Kansas S. R.	Thorndike R.	2Ayres S.	Memory Tests					Digits	2Cancellation	2Word Building	2Completion	2Opposites
	Years	Months					1Logical	2Related W.	2Unrelated W.	2Concrete W.	2Abstract W.					
1	10	8	17	18.4	8.8	51	101	20	16	74	62	7	86	37	52	29
2	9	11	19	18.4	9.4	58	92	25	14	87	70	7	80	44	51	25
3	11	4	25	13.9	7.0	59	73	27	22	77	71	7	100	43	46	20
4	11	4	11	15.4	8.6	49	102	22	17	76	66	6	111	37	52	32
5	10	10	17	18.5	8.2	53	82	25	21	80	65	7	127	44	56	33
6	9	2	19	20.2	8.8	54	90	22	12	86	64	6	118	27	58	37
7	9	11	25	16.1	8.8	55	97	30	23	82	67	6	130	33	51	25
8	10	0	15	8.6	7.6	55	86	24	20	82	72	7	85	43	54	43
9	9	8	20	18.5	6.6	58	78	15	14	62	53	7	83	21	50	15
10	9	6	16	18.4	6.6	53	68	28	17	82	72	6	153	38	43	29
11	10	6	11	13.2	6.6	53	85	21	16	75	64	6	115	28	51	28
12	10	4	13	10.2	6.4	51	104	19	13	73	57	6	98	28	55	27
13	10	0	11	6	7.0	43	64	20	14	64	50	6	72	29	49	25
14	9	7	11	19.5	5.8	43	85	18	15	70	61	6	72	23	47	26
15	9	2	5	5.3	6.4	51	68	21	15	62	52	5	100	27	41	22
16	9	0	3	11.5	6.8	34	66	18	19	65	47	6	80	32	45	23
17	10	6	2	10.4	5.2	45	63	18	14	71	56	5	68	25	35	23
18	11	0	11	7.6	6.6	54	53	17	11	61	48	6	102	32	44	19
19	9	0	10	12.8	5.8	40	68	16	15	55	50	7	72	31	39	25
20	10	0	22	9.7	6.4	34	60	21	16	49	39	5	59	30	40	31
21	9	8	9	8.8	6.8	32	60	16	15	36	32	6	101	27	39	18
22	9	2	10	9.1	5.9	38	42	18	13	56	30	6	80	21	48	25
23	9	8	10	11.9	6.0	52	52	19	10	59	47	5	70	25	44	22
24	9	9	9	6.5	4.8	36	41	21	12	50	42	6	52	14	44	21

<sup>1</sup>This score was secured by adding the scores made in each of the four fundamental operations.<sup>2</sup>This score is the total of the individual scores.

TABLE III  
FIFTH GRADE (V)

			EDUCATIONAL TESTS						MENTAL TESTS									
No. of Pupil	Ages		Courtis A.	Woody A.	Kansas S. R.	Thorndike R.	Ayres S.	Thorndike W.	Memory Tests						Cancellation	Word Building	Completion	Opposites
	Years	Months							Logical	Related W.	Unrelated W.	Concrete W.	Abstract W.	Digits				
1	10	11	35	439	20.3	9.4	58	10	127	32	27	98	86	7	166	58	61	35
2	11	11	27	450	19.9	10.2	54	11	109	33	26	85	81	7	139	53	66	43
3	11	1	36	460	16.7	10.2	57	11	97	30	23	88	71	8	189	57	56	36
4	9	7	20	386	12.8	8	53	10	119	20	20	84	75	7	112	45	57	49
5	10	6	23	329	21.7	10.1	56	11	126	28	15	108	74	8	164	47	58	50
6	11	0	24	371	18.4	10.2	60	9	95	23	20	80	76	8	119	55	54	35
7	11	0	24	310	16.7	8.6	59	10	106	24	15	86	66	7	139	62	57	37
8	11	6	15	335	18.4	10.1	57	9	104	23	16	79	74	6	153	55	56	37
9	11	6	15	305	14.4	8.6	50	8	69	20	22	68	80	7	183	24	57	43
10	10	0	22	278	6.2	7.6	51	9	96	23	18	69	67	7	124	43	53	38
11	9	6	20	322	14.8	9.4	59	10	101	31	17	86	93	6	186	37	53	39
12	10	0	18	302	14.8	8.6	43	9	83	28	19	78	67	7	107	29	45	31
13	9	7	9	268	19.7	9.4	54	9	74	19	12	62	61	6	96	24	48	36
14	12	4	12	317	15	9	54	12	98	23	16	69	69	7	149	21	54	26
15	12	3	9	282	10.4	10	54	9	104	27	22	67	66	6	113	34	54	32
16	12	5	14	340	9.0	8.4	55	14	80	19	19	80	48	7	110	17	44	29
17	12	5	14	320	11.3	10	50	14	64	17	14	74	79	7	121	31	52	29
18	11	1	12	298	6.2	7.2	50	12	66	18	18	76	60	6	92	28	53	31
19	10	2	12	187	13.4	5.6	39	12	70	18	19	69	53	7	80	32	55	23
20	12	1	11	268	15.5	6	39	11	66	22	11	59	60	7	77	26	49	27
21	11	7	11	239	13.1	9	52	11	93	27	20	77	63	7	99	28	44	34
22	10	3	8	251	12.5	7.6	48	8	79	18	10	66	57	6	98	19	41	34
23	11	8	2	250	3.9	6.8	53	2	74	19	12	70	56	6	74	8	45	25
24	13	2	5	221	12.5	8	45	5	29	17	6	73	63	6	72	29	38	29

<sup>1</sup>This score is the sum of the scores made in each of the four fundamental operations.

TABLE IV  
SIXTH GRADE (VI)

			EDUCATIONAL TESTS						MENTAL TESTS									
No. of Pupil	Ages		Courtis A.	Woody A.	Kansas S. R.	Thorndike R.	Ayres S.	Thorndike W.	Memory Tests					Cancellation	Word Building	Completion	Opposites	
	Years	Months							Logical	Related W.	Unrelated W.	Concrete W.	Abstract W.					
																		Digits
1	12	10	33	503	25.4	9.6	58	11	119	30	21	109	96	8	137	55	61	40
2	12	6	36	611	18.4	10.7	58	12	117	26	21	84	79	7	165	54	61	32
3	12	4	32	567	18.4	9.4	54	11	114	28	27	83	83	7	148	41	57	33
4	12	3	32	576	25.4	9.4	60	11	99	30	23	87	72	7	205	51	58	37
5	12	3	30	517	12.9	9.4	43	10	94	27	21	83	64	6	160	56	48	30
6	12	7	28	544	17.3	10.1	60	12	119	30	22	79	72	6	159	44	57	37
7	12	1	25	563	12.6	9.4	49	12	107	26	19	78	65	7	172	50	60	37
8	12	1	9	490	12.4	9.8	53	9	87	25	19	82	77	5	118	53	57	28
9	10	7	18	501	25.4	8.0	55	11	94	24	18	96	93	7	151	44	56	29
10	12	10	25	550	10.6	10.4	44	10	118	28	23	92	68	8	134	46	52	27
11	11	5	5	367	18.3	8.2	53	10	121	25	17	82	85	7	147	35	60	41
12	12	5	13	476	15.8	9.4	53	9	94	22	23	75	77	7	122	55	58	26
13	11	10	19	480	25.4	8.8	43	10	94	26	17	91	75	7	211	48	54	27
14	13	5	20	490	6.3	8.8	58	10	93	24	16	81	71	6	123	40	56	29
15	12	11	17	480	19.7	9.6	52	9	77	22	12	72	52	7	101	40	48	33
16	11	9	13	485	17.1	8.6	44	10	90	23	16	81	49	6	107	33	50	40
17	12	0	26	366	16.1	10.1	57	8	88	28	20	93	80	7	126	45	52	33
18	11	10	15	416	8.9	9.4	56	10	62	26	24	88	60	7	131	15	56	30
19	12	9	22	505	10.6	8.6	46	12	117	25	19	88	62	6	142	46	55	30
20	12	9	5	452	15.4	10	43	10	90	27	21	95	56	6	102	45	49	30
21	12	10	11	353	13.4	8.8	56	9	88	26	18	80	71	7	97	38	53	30
22	12	11	17	478	10.6	8.0	56	11	77	21	15	82	84	5	138	17	51	31
23	11	10	16	487	13.4	6.6	46	9	91	20	15	75	66	5	142	32	48	29
24	12	5	18	390	17.3	9.6	39	9	97	28	19	89	65	5	116	46	53	33
25	10	5	16	497	16.1	7.6	36	7	51	21	9	75	50	5	71	44	47	36
26	11	2	18	480	12.2	10.1	53	13	88	24	20	64	74	6	128	36	57	33
27	12	5	10	460	8.5	5.0	35	9	92	24	21	88	45	6	108	43	52	18
28	12	3	8	451	21.4	10	47	9	91	24	20	81	72	7	101	31	55	40
29	12	0	21	553	16.1	7.2	44	9	76	21	16	87	65	6	106	36	48	33
30	11	0	8	408	6.3	8.6	48	8	63	17	2	63	42	6	85	39	47	16

TABLE V  
SEVENTH GRADE (VII)

			EDUCATIONAL TESTS						MENTAL TESTS									
No. of Pupil	Ages		Curtis A.	Woody A.	Kansas S.R.	Thorndike R.	Ayres S.	Thorndike W.	Memory Tests						Cancellation	Word Building	Completion	Opposites
	Years	Months.							Logical	Related W.	Unrelated W.	Concrete W.	Abstract W.	Digits				
1	14	0	46	680	34.6	11	55	11	113	31	22	92	82	9	153	59	70	42
2	12	4	36	632	16.1	11	59	11	112	26	23	95	79	8	184	33	66	51
3	12	5	25	641	12.8	10	47	10	107	28	24	101	84	7	127	38	65	27
4	13	3	62	643	22.5	11	55	11	121	31	21	95	82	7	191	45	60	57
5	12	7	33	598	23.4	9	49	9	121	28	25	91	85	7	193	32	56	41
6	13	7	28	539	32.3	10	49	10	129	26	26	99	97	7	183	57	66	46
7	12	9	35	600	22.3	10	46	10	117	26	16	86	62	7	173	54	64	48
8	13	4	42	590	14.8	9	44	9	80	26	27	96	70	8	158	42	53	44
9	14	7	28	500	8.5	9	34	9	91	28	20	101	78	7	218	35	53	49
10	13	11	25	444	17.5	6	41	6	106	21	17	82	62	8	138	41	59	26
11	14	2	25	492	18.4	8	43	8	99	27	21	86	63	7	149	26	57	38
12	11	10	40	580	26.3	10	49	10	117	24	20	85	89	8	167	43	58	47
13	11	4	22	513	10.9	8	29	8	107	24	21	80	57	7	118	33	53	36
14	12	1	30	593	14.8	10	51	10	104	27	21	85	62	8	178	42	58	39
15	14	4	18	498	11.1	9	49	9	71	21	17	78	59	7	120	39	53	24
16	13	1	31	578	18.1	9	43	9	87	22	9	76	55	7	218	31	50	43
17	14	4	1	264	14.4	12	43	12	89	22	15	75	60	7	113	28	51	42
18	13	7	19	443	21.0	8	37	8	94	24	19	86	71	7	115	13	49	40
19	13	6	20	573	8.4	8	38	8	101	22	21	77	60	7	155	26	52	26
20	13	10	17	362	8.1	11	24	11	67	19	15	74	65	5	101	25	47	18
21	14	2	18	369	13.4	10	44	10	105	23	18	69	56	7	208	32	52	33
22	13	7	22	519	13.5	10	54	10	95	21	14	81	71	7	141	42	56	29
23	13	2	18	490	13.4	10	46	10	70	25	15	84	85	7	177	45	44	30
24	13	0	15	497	19.1	10	57	10	100	24	16	88	75	7	172	35	53	42
25	13	5	29	506	14.3	11	58	11	99	23	15	61	60	6	173	25	46	33
26	12	10	32	514	9.1	9	26	9	96	21	13	76	55	6	113	25	34	21
27	12	4	9	338	10.7	10	52	10	98	21	14	75	55	6	112	41	54	43
28	14	0	26	465	26.1	8	21	8	93	19	17	73	62	7	164	21	51	29
29	13	0	21	369	13.8	9	42	9	91	19	19	63	57	7	135	22	46	30
30	12	5	11	469	14.4	9	30	9	69	15	9	74	55	6	125	28	42	27

## PART III

### INTERPRETATION OF RESULTS

1. *Central Tendency and Variability for Each Grade and Group.*—The central tendency and variability for each grade and group are given in Tables VIA to VIM for each test. From an examination of the tables it is seen that G. 1 in each grade surpasses the whole grade and the other groups of that grade in each test except the Thorndike handwriting test. In 39 cases out of 49, G. 2 surpasses G. 3 and G. 4 of the same grade. In 40 cases out of 49, G. 4 makes a poorer average score than either of the other groups of the grade. The most striking thing in these results is that in a majority of cases the best group in a grade surpasses the second best group in the grade immediately above. For example, G. 1 of the sixth grade surpasses G. 2 of the seventh grade in 10 cases out of 13. In 7 cases out of 13 the tables show less absolute difference between G. 1 of the seventh grade and G. 1 of the fourth grade than between G. 1 and G. 4 of the seventh grade.

TABLE VI

#### CENTRAL TENDENCY AND VARIABILITY BY GRADES AND GROUPS FOR EACH TEST

A. COURTIS ARITHMETIC TESTS										
Grade	Whole G.		G. 1		G. 2		G. 3		G. 4	
	<i>Av.</i>	<i>A. D.</i>	<i>Av.</i>	<i>A. D.</i>	<i>Av.</i>	<i>A. D.</i>	<i>Av.</i>	<i>A. D.</i>	<i>Av.</i>	<i>A. D.</i>
VII	29.8	.36	42.0	.3	34.2	.1	22.2	.37	21.5	.4
VI	24.4	.3	36.0	.2	22.0	.2	20.9	.2	18.3	.17
V	21.8	.44	38.0	.2	23.7	.18	13.1	.3	11.7	.2
IV	13.4	.39	18.0	.13	16.7	.24	7.2	.54	11.7	.3

B. WOODY ARITHMETIC TESTS										
Grade	Whole G.		G. 1		G. 2		G. 3		G. 4	
	<i>Av.</i>	<i>A. D.</i>	<i>Av.</i>	<i>A. D.</i>	<i>Av.</i>	<i>A. D.</i>	<i>Av.</i>	<i>A. D.</i>	<i>Av.</i>	<i>A. D.</i>
VII	508	.13	619	.05	526	.08	442	.21	451	.12
VI	483	.1	555	.05	479	.06	443	.18	462	.08
V	314	.16	406	.1	309	.03	304	.06	263	.09

C. THORNDIKE READING TESTS										
Grade	Whole G.		G. 1		G. 2		G. 3		G. 4	
	<i>Av.</i>	<i>A. D.</i>	<i>Av.</i>	<i>A. D.</i>	<i>Av.</i>	<i>A. D.</i>	<i>Av.</i>	<i>A. D.</i>	<i>Av.</i>	<i>A. D.</i>
VII	8.4	.1	9.7	.03	8.7	.06	7.8	.14	7.7	.07
VI	9.	.1	9.7	.05	9.1	.07	8.8	.07	8.3	.18
V	8.6	.14	9.7	.06	8.8	.07	8.8	.13	7.2	.12
IV	7.0	.14	8.5	.07	7.1	.09	6.3	.08	5.9	.08

D. KANSAS SILENT READING TESTS										
Grade	Whole G.		G. 1		G. 2		G. 3		G. 4	
	<i>Av.</i>	<i>A. D.</i>	<i>Av.</i>	<i>A. D.</i>	<i>Av.</i>	<i>A. D.</i>	<i>Av.</i>	<i>A. D.</i>	<i>Av.</i>	<i>A. D.</i>
VII	21.2	.27	28.3	.24	23.9	.14	15.7	.36	17.2	.29
VI	18.7	.18	21.7	.09	19.2	.13	18.	.27	15.9	.19
V	18.5	.34	23.3	.17	19.	.4	19.	.34	12.8	.19
IV	12.9	.31	17.5	.1	14.1	.24	10.1	.36	9.8	.19



# Variation Within the Grades

21

## E. AYRES SPELLING TESTS

Grade	Whole G.		G. 1		G. 2		G. 3		G. 4	
	Av.	A. D.	Av.	A. D.	Av.	A. D.	Av.	A. D.	Av.	A. D.
VII	42.8	.17	51.4	.08	42.5	.14	41.	.15	36.6	.32
VI	49.2	.15	52.	.1	50.5	.11	50.6	.11	43.	.13
V	52.5	.1	56.3	.04	53.	.1	53.	.05	46.	.11
IV	48.	.18	54.	.06	54.	.06	45.	.13	42.	.12

## F. THORNDIKE HANDWRITING TEST—LEGIBILITY

Grade	Whole G.		G. 1		G. 2		G. 3		G. 4	
	Av.	A. D.	Av.	A. D.	Av.	A. D.	Av.	A. D.	Av.	A. D.
VII	9.5	.11	10.3	.06	8.6	.01	9.7	.12	9.4	.08
VI	10.0	.11	11.3	.05	9.7	.06	9.8	.1	9.1	.12
V	9.8	.03	10.3	.07	9.1	.05	9.1	.05	9.0	.05

## G. THORNDIKE HANDWRITING TEST—SPEED

Grade	Whole G.		G. 1		G. 2		G. 3		G. 4	
	Av.	A. D.	Av.	A. D.	Av.	A. D.	Av.	A. D.	Av.	A. D.
VII	86.3	.12	83.4	.11	88.6	.16	85.1	.15	88	.08
VI	59.8	.13	70	.11	56.2	.1	56.3	.16	57.4	.07
V	55.8	.16	55.2	.16	53.7	.11	63.3	.15	49.7	.11

## H. LOGICAL MEMORY TESTS

Grade	Whole G.		G. 1		G. 2		G. 3		G. 4	
	Av.	A. D.	Av.	A. D.	Av.	A. D.	Av.	A. D.	Av.	A. D.
VII	97.0	.13	117	.05	97	.13	88.5	.12	88.5	.14
VI	93.6	.14	109	.08	97.2	.12	88	.11	79.7	.18
V	87.6	.2	108	.09	93.1	.11	81	.16	68.5	.2
IV	68.5	.25	87.1	.08	81	.09	60.1	.12	45.7	.21

## I. ROTE MEMORY FOR WORDS TESTS

Grade	Whole G.		G. 1		G. 2		G. 3		G. 4	
	Av.	A. D.	Av.	A. D.	Av.	A. D.	Av.	A. D.	Av.	A. D.
VII	192.3	.12	221	.06	199.4	.08	181.6	.07	172	.07
VI	196.7	.08	212	.07	202	.06	194.5	.06	178	.09
V	185.2	.11	215	.07	191.5	.03	172	.05	161	.06
IV	164	.14	185	.06	196.5	.1	149.5	.06	124.5	.09

## J. WORD-BUILDING TESTS

Grade	Whole G.		G. 1		G. 2		G. 3		G. 4	
	Av.	A. D.	Av.	A. D.	Av.	A. D.	Av.	A. D.	Av.	A. D.
VII	35.3	.24	45.4	.21	37.6	.12	30.2	.24	26.7	.3
VI	41.9	.13	50.1	.09	45.1	.12	34	.27	39.3	.11
V	35	.34	47.5	.12	41.7	.28	26	.2	23.7	.3
IV	30.8	.2	38.7	.11	32	.2	28	.11	24.7	.19

## K. COMPLETION TESTS

Grade	Whole G.		G. 1		G. 2		G. 3		G. 4	
	Av.	A. D.	Av.	A. D.	Av.	A. D.	Av.	A. D.	Av.	A. D.
VII	53.9	.11	64	.05	55.5	.04	50	.05	46.4	.11
VI	53.8	.07	57.4	.04	55	.05	51.8	.05	51.3	.07
V	52.1	.1	58.5	.06	53.5	.06	50.8	.06	45.3	.09
IV	47.2	.11	52.2	.06	50.6	.06	43.5	.09	42.3	.07

## L. CANCELLATION TESTS

Grade	Whole G.		G. 1		G. 2		G. 3		G. 4	
	Av.	A. D.	Av.	A. D.	Av.	A. D.	Av.	A. D.	Av.	A. D.
VII	155	.18	172	.1	156	.16	153	.23	142	.16
VI	133	.11	164	.09	138	.17	123	.12	108	.11
V	123	.11	148	.15	150	.15	113	.11	84	.12
IV	91	.23	104	.1	108	.22	83	.14	69	.22

## Variation Within the Grades

M. OPPOSITES TESTS									
Whole G.		G. 1		G. 2		G. 3		G. 4	
Grade	Av. A. D.	Av. A. D.	Av. A. D.	Av. A. D.	Av. A. D.	Av. A. D.	Av. A. D.	Av. A. D.	Av. A. D.
VII	36.7 .23	44.5 .15	38 .18	32.6 .22	32.1 .18	31.6 .09	29.8 .2	28.5 .12	23.6 .14
VI	31.6 .11	35.1 .08	30 .12	30.5 .08	28 .12	30.5 .08	28 .12	28 .12	23.6 .14
V	34.5 .12	41.1 .15	37.5 .07	30.5 .08	28 .12	30.5 .08	28 .12	28 .12	23.6 .14
IV	26 .17	29.3 .16	28 .2	23 .07	23 .07	23 .07	23 .07	23 .07	23 .07

2. *Relation Between Position Held in the Grade, According to Teachers' Judgment, and Position Held in the Four Grades Combined, According to the Results of the Tests.*

TABLE VII

PER CENT OF THE SCORES MADE BY EACH GRADE AND GROUP FALLING BETWEEN CERTAIN POINTS IN A TOTAL ARRAY OF THE EDUCATIONAL TEST SCORES COMBINED

Grade and Group		Above 75 Percentile	50 to 75 Percentile	25 to 50 Percentile	Below 25 Percentile
VII	G. 1	71.4	28.6		
VII	G. 2	50.0	37.5	12.5	
VII	G. 3	37.5	12.5	25.0	25.0
VII	G. 4	28.6	14.3	28.6	28.6
VII	W. G.	46.7	23.3	16.7	13.3
VI	G. 1	57.1	28.6	14.3	
VI	G. 2	25.0	50.0	25.0	
VI	G. 3	12.5	37.5	25.0	25.0
VI	G. 4	28.6	14.3	28.6	28.6
VI	W. G.	23.3	43.3	20.0	13.3
V	G. 1	50.0	33.3	16.7	
V	G. 2	33.3	16.7		50.0
V	G. 3	33.3	16.7	16.7	33.3
V	G. 4			83.3	16.7
V	W. G.	29.1	16.7	29.1	25.0
IV	G. 1		33.3	66.7	
IV	G. 2		16.7	50.0	33.3
IV	G. 3		16.7		83.3
IV	G. 4			16.7	83.3
IV	W. G.		16.7	33.3	50.0

Table VII shows the average position the members of each grade and group hold in a total array of all the educational test scores for the four grades combined. For the seventh grade, 71.4 per cent of the members of G. 1 fall in the best 25 per cent of the scores as compared to 46.7 per cent for the whole grade. Similarly we have 57.1 and 23.3 per cents for the sixth grade and 50 and 29.1 per cents for the fifth grade, while no pupil in the fourth grade attained a position in the best 25 per cent of all the scores. No pupil in the G. 1 groups made a score falling in the poorest 25 per cent of all the scores, while for the whole grades we have the following per cents falling in that group: seventh, 13.3; sixth, 13.3; fifth, 25; and fourth, 50.

So far as these tests are a measure of ability in school subjects, the results show plainly the superiority of the G. 1 groups over the others. If we should neglect the present grades and attempt to regroup the children into four groups based on ability shown in these tests, the results show that the following per cents would be taken from each grade for each of the four new groups (No. 1 being the best group):

Group	Seventh Grade	Sixth Grade	Fifth Grade	Fourth Grade
1	46.7	23.3	29.1	
2	23.3	43.3	16.7	16.7
3	16.7	20.0	29.1	33.3
4	13.3	13.3	25.0	50.0

TABLE VIII

PER CENT OF THE SCORES MADE BY EACH GRADE AND GROUP FALLING BETWEEN CERTAIN POINTS IN A TOTAL ARRAY OF THE MENTAL TEST SCORES COMBINED

Grade and Group		Above 75 Percentile	50 to 75 Percentile	25 to 50 Percentile	Below 25 Percentile
VII	G. 1	85.7	14.3		
VII	G. 2	50.0	25.0	25.0	
VII	G. 3	25.0	25.0	37.5	12.5
VII	G. 4	14.3	28.6	28.6	28.6
VII	W. G.	43.3	23.3	23.3	10.0
VI	G. 1	57.1	42.9		
VI	G. 2	37.5	25.0	25.0	12.5
VI	G. 3	12.5	37.5	37.5	12.5
VI	G. 4	14.3	28.6	28.6	28.6
VI	W. G.	30.0	33.3	23.3	13.3
V	G. 1	50.0	33.3	16.7	
V	G. 2	33.3	33.3	16.7	16.7
V	G. 3		33.3	33.3	33.3
V	G. 4		16.7	16.7	66.7
V	W. G.	20.0	29.2	20.9	29.2
IV	G. 1		33.3	33.3	33.3
IV	G. 2		16.7	50.0	33.3
IV	G. 3			33.3	66.7
IV	G. 4			16.7	83.3
IV	W. G.		12.5	33.3	54.2

The position the members of each grade and group hold in a total array of the combined mental tests scores is shown in Table VIII. An examination of the table shows a considerable overlapping both between the grades and between the groups. Taken by grades, the best 50 per cent of all the pupils is made up as follows: 66.7 per cent of the seventh grade, 63.3 per cent of the sixth grade, 50.1 per cent of the fifth grade, and 12.5 per cent of the fourth grade. As a rule, the members of G. 1 and G. 2 tend to fall above the

median, while the members of G. 3 and G. 4 tend to fall below it. The poorest 27 children of the 108 children come from the four grades in the following per cents: seventh, 10; sixth, 13.3; fifth, 29.2; and fourth, 54.2. If we should attempt to regroup the children of the four grades into four new groups based on ability shown in the mental tests, each grade would contribute the per cents shown in the summary below to the new groups:

Group	Seventh Grade	Sixth Grade	Fifth Grade	Fourth Grade
1	43.3	30.0	20.0	
2	23.3	33.3	29.2	12.5
3	23.3	23.3	20.9	33.3
4	10.0	13.3	29.2	54.2

3. *Relation Between Accomplishment and Accuracy.*—For the purpose of studying the relation between accomplishment and accuracy we have taken for accomplishment the combined score for each of the tests before allowance has been made for errors on the basis mentioned when the method of scoring the tests was given in detail. As a measure of accuracy, we have taken the total number of errors made in each test. In some tests, as the opposites test, where the score is simply the number of opposites given, we have tabulated the number of wrong responses, and these have been included here. The pupil making fewest absolute errors in any test has been considered best in point of errors in that test. A positive correlation in this case indicates that there is a tendency for accomplishment to be accompanied by accuracy. It should be noticed that the coefficient of correlation has no significance in several cases. In the Ayres spelling test and the Thorndike reading test each pupil attempted all the words given. In these cases there should be a perfect correlation between the number of errors made and score. A somewhat higher coefficient would have been found in each case if we had used the relative number of errors instead of absolute errors.

TABLE IX  
CORRELATION BETWEEN ACCOMPLISHMENT AND ACCURACY

Test	Coefficient
Courtis Arithmetic -----	54
Kansas Silent Reading -----	52
Logical Memory -----	47
Rote Memory for Words -----	34
Cancellation -----	10
Word Building -----	23
Opposites -----	28

It should be noticed that these coefficients are the average secured for the four grades. In the case of the cancella-

tion and word-building tests, several of the grades gave small negative coefficients. On the whole, there appears to be a positive relationship between accomplishment and accuracy. The difference in the relationship between accomplishment and accuracy in the educational tests and the mental tests can partially be explained. In the educational tests, especially the arithmetic tests, the pupils have had much previous work where accuracy has been emphasized. In the rote memory for word tests there was no central controlling idea as in the logical memory tests; consequently more irrelevant ideas came to hand. The fact that none of the pupils had done similar tasks to the rote memory for words tests, while they had done similar work to the logical memory tests, probably explains the difference in the relation between accomplishment and accuracy in the two tests. In the cancellation tests there had been no previous practice; consequently there was no adjustment between speed and accuracy. Previous work in school doubtless aided in the word-building and opposites tests.

TABLE X

AVERAGE RANK IN ACCURACY HELD IN THE GRADE BY THE MEMBERS OF EACH GROUP

Grade	G. 1	G. 2	G. 3	G. 4
VII	4.3	13.6	17.7	24
VI	5.6	14.3	16.6	25.6
V	5.2	10.2	15.2	19.3
IV	4.2	9.2	17	19.7

In Table X is shown the average position each group holds in the grade in accuracy. The results were secured by making a combined ranking of all the absolute errors of the nine series of tests. This was done for each grade by first making a ranking for each test. These rankings were then combined by adding the numbers representing the ranks each pupil held in all the tests. The sums thus obtained were rearranged, and the pupil holding the smallest total was given first place. The errors from the Ayres spelling test and the Thorndike reading test were included in the totals from which the final ranking was secured. These tend to make a somewhat higher correlation than would otherwise be expected. It is seen from the table that the best groups in each grade surpass in accuracy the other groups of the grade. Likewise G. 4 is surpassed by all the other groups of the grade.

4. *Relation Between Accomplishment and School Standing.*—For the purpose of studying the relation between accomplishment in the tests and class standing we have combined the scores for each of the tests after allowance has

been made for errors as described in Part I. The class standing of each pupil is determined by the grades he received in each subject during the school year. The method by which each pupil's relative standing in the grade was secured is given in Part I.

TABLE XI  
CORRELATION BETWEEN ACCOMPLISHMENT IN THE EDUCATIONAL  
TESTS AND SCHOOL STANDING

Grade -----	IV	V	VI	VII	
No. of Cases -----	24	24	30	30	Av.
Courtis A. and Arithmetic-----	42	78	73	51	61
Woody A. and Arithmetic-----		59	62	60	60
Thorndike Handwriting and Penmanship---		74	62	51	62
Kansas S. R. and Reading-----	68	67	52	22	52
Thorndike Reading and Reading-----	57	50	28	47	45
Ayres Spelling and Spelling-----	31	77	50	69	57

An examination of Table XI shows the relation between the educational tests and class standing in the corresponding school study. The coefficients are fairly high in each case.

A combined ranking has been made from the separate rankings in the different school subjects. Likewise a combined ranking has been made for the mental tests. These have been correlated and the following coefficients of correlation found for the grades:

Fourth Grade -----	73
Fifth Grade -----	71
Sixth Grade -----	67
Seventh Grade -----	61
Average -----	68

A similar combination of the rankings of the educational tests gives the following coefficients of correlation when correlated with school standing:

Fourth Grade -----	75
Fifth Grade -----	83
Sixth Grade -----	58
Seventh Grade -----	71
Average -----	72

5. *Relation Between Teachers' Judgment and Accomplishment.*—The pupils in each of the four grades used in the study were rated from best to poorest by the several teachers who had taught or were teaching the grades. These rankings were then combined, and the new ranking has been used throughout the study, the rank each pupil held having been given him as his number in the grade. For purposes of comparison, the rank of the pupils in each test has been given.

TABLE XII

CORRELATION BETWEEN TEACHERS' JUDGMENT AND ACCOMPLISHMENT  
IN THE EDUCATIONAL TESTS

Fourth Grade -----	79
Fifth Grade -----	81
Sixth Grade -----	75
Seventh Grade -----	70
Average -----	74

It should be noticed that in securing these coefficients a great number of tests have been used. For the fourth grade nine individual tests were used. Fourteen individual tests contributed to the figures from which the coefficients were derived for each of the fifth, sixth, and seventh grades.

Table XIII gives the coefficients secured when accomplishment in the mental tests is correlated with teachers' judgment. Thirty-four individual measurements contributed to the figures representing accomplishment. Each coefficient is, therefore, partially determined by each of a large number of measurements.

TABLE XIII

CORRELATION BETWEEN TEACHERS' JUDGMENT AND ACCOMPLISHMENT  
IN THE MENTAL TESTS

Fourth Grade -----	83
Fifth Grade -----	79
Sixth Grade -----	80
Seventh Grade -----	74
Average -----	79

It is significant that there is higher correlation between attainment in the mental tests and teachers' judgment than between attainment in the educational tests and teachers' judgment. This probably can be explained by the fact that a much greater number of mental tests were used, thereby tending to more nearly equalize errors. Again, the teachers were requested to rate the pupils according to ability, regardless of classroom results.

Terman ('16) found a coefficient of 48 between teachers' judgment and IQ's. He asked the teachers to rate the pupils on a scale of five, and this ranking was correlated with the result secured when the children were tested with the Stanford Revision of the Binet-Simon Scale. Terman and Binet ('11) are inclined to believe that teachers are unable to rate children with any degree of accuracy. This is probably true when children are rated in the abstract on a five-point scale (as Terman instructed his teachers) as (1) very bright, (2) bright, (3) average, (4) dull, and (5) very dull. Our results show that teachers are able to rate children by

comparison with other children with a surprising degree of accuracy.

TABLE XIV

AVERAGE RANK ATTAINED IN THE GRADE BY THE MEMBERS OF EACH GROUP IN THE EDUCATIONAL TESTS

<i>Grade</i>	<i>G. 1</i>	<i>G. 2</i>	<i>G. 3</i>	<i>G. 4</i>
VII	4.6	15.3	20.1	21.1
VI	4.2	15.4	18	23.1
V	4.5	11.3	13	21.1
IV	5	9.1	18.1	17.5

It is seen from Table XIV that G. 1 in every grade has a higher relative position than either of the other groups of the grade. Similarly, G. 4 for each grade except the fourth has a lower relative position than the other groups of the grade. There is very little difference in the relative positions held by G. 2 and G. 3 of the fifth grade.

Table XV shows the average position the members of each group hold in their grades in the mental tests. Here, as stated before, 34 measurements determine the figures upon which the rankings are based. G. 1 in each grade holds a higher average position than the other groups of the grade. G. 4 holds a position inferior to the other groups.

TABLE XV

AVERAGE RANK ATTAINED IN THE GRADE BY THE MEMBERS OF EACH GROUP IN THE MENTAL TESTS

<i>Grade</i>	<i>G. 1</i>	<i>G. 2</i>	<i>G. 3</i>	<i>G. 4</i>
VII	4.7	12.6	20.6	23.6
VI	5.3	13.1	20	22.8
V	4	9.7	15.8	20.7
IV	5.5	7.5	16.8	20.1



TABLE XVIa  
FOURTH GRADE (IV)

RANK OF PUPILS IN THE DIFFERENT TESTS

No. of Pupil	Courtis Arith.	Kansas S. R.	Thorndike R.	Ayres Spelling	Logical Memory	Memory Words	Memory Digits	Cancellation	Word Building	Completion	Opposites	Final Rank
1	7.5	6	3	13	3	9	2.5	12	6.5	5.5	6.5	5
2	5.5	6	1	2.5	5	4.5	5	17	1.5	8	13	3
3	1.5	10	8.5	1	12	3	2.5	9.5	3.5	14	21	7
4	14	9	5	14	2	7	10	6	6.5	5.5	4	6
5	7.5	3.5	6	9	10	6	1	3	1.5	2	3	1
6	5.5	1	3	6.5	6	10	18	4	17	1	2	4
7	1.5	8	3	4.5	4	1	10	2	8	8	13	2
8	10	20	7	4.5	7	4.5	6.5	13	3.5	4	1	8
9	4	3.5	13.5	2.5	11	16	4	15	22.5	10	14	11
10	9	6	13.5	9	14	2	10	1	5	19	6.5	9
11	14	11	13.5	9	8.5	8	9.5	5	14.5	8	8	10
12	11	16	17	13	1	12	8	14	14.5	3	9	12
13	14	23	8.5	17.5	17	15	15	19.5	13	11	13	14
14	14	2	21.5	17.5	8.5	11	13	18	21	13	10	13
15	22	24	17	13	14	14	19.5	9.5	17	20	18.5	19
16	23	14	10.5	22.5	16	17	16.5	17	9.5	15	16.5	18
17	24	15	23	17	18	13	23	21	19.5	24	16.5	23
18	14	21	13.5	6.5	21	18	24	7	9.5	17	22	17
19	18	12	21.5	19	14	19	6.5	19.5	11	22.5	13	16
20	3	17	17	22.5	19.5	22	22	22	12	21	5	15
21	20.5	19	10.5	24	19.5	24	16.5	8	17	22.5	23	22
22	18	18	20	20	23	23	13	17	22.5	12	13	20
23	18	13	19	11	22	20.5	21	24	19.5	17	18.5	21
24	20.5	22	24	21	24	20.5	13	23	24	17	20	24

TABLE XVIIb  
FIFTH GRADE (V)

RANK OF PUPILS IN THE DIFFERENT TESTS

No. of Pupil	Courtis Arith.	Woody Arith.	Handwriting	Kansas S. R.	Thorndike R.	Ayres Spelling	Logical Memory	Memory Words	Memory Digits	Cancellation	Word Building	Completion	Opposites	Final Rank
1	2	2	7	2	9	4	1	1	6	4	9	2	11.5	2
2	3.5	1	2	3	3	10.5	4	2.5	20	8.5	4	1	1	4
3	1	3	2	7.5	3	5.5	10	4	1	1	1	7.5	9.5	1
4	8	4	7	16	17.5	13.5	3	6.5	4	14	7	5	2	8
5	3.5	8	2	1	4.5	7	2	2.5	10	5	6	3	1	3
6	6	5	16	5.5	3	1	12	6.5	12	12	2.5	10	11.5	5
7	5	11.5	7	7.5	14	2.5	5	10	2.5	8.5	5	5	7.5	6
8	11	6	16	5.5	4.5	5.5	6.5	8.5	20	6	2.5	7.5	7.5	7
9	12	15	23	13	14	18	20	11	2.5	3	19.5	5	3	13
10	7	18	16	22.5	19.5	16	11	15.5	8.5	10	8	13	6	10
11	9	9.5	7	11.5	9	25	8	5	17	2	10	13	5	9
12	10	14	16	11.5	14	22	14	8.5	11	16	14.5	19	16.5	15
13	20	16	16	4	9	10.5	17.5	22	15	19	19.5	18	9.5	16
14	15	11.5	16	10	11.5	10.5	9	15.5	8.5	7	21	10	22	12
15	21	17	16	20	6.5	10.5	6.5	14	22.5	13	11	10	15	14
16	14	9.5	16	21	16	8	15	18	12	15	23	21.5	19	17
17	13	7	7	19	6.5	18	21	13	10	11	13	16	19	11
18	16	13	23	22.5	21	18	22.5	17	17	20	16.5	13	16.5	19
19	19	22	16	14	24	23.5	19	19.5	6	21	12	15	24	20
20	18	19	16	9	23	23.5	22.5	23	17	22	18	17	21	22
21	17	21	16	15	11.5	15	13	12	14	17	16.5	21.5	13.5	18
22	22	23	23	17.5	19.5	20	16	24	24	18	22	23	13.5	21
23	24	20	7	24	22	13.5	17.5	21	22.5	23	24	20	23	24
24	23	24	7	17.5	17.5	21	24	19.5	20	24	14.5	24	19	23

TABLE XVIc  
SIXTH GRADE (VI)

RANK OF PUPILS IN THE DIFFERENT TESTS

No. of Pupil	Courtis Arith.	Woody Arith.	Handwriting	Kansas S. R.	Thorndike R.	Ayres Spelling	Logical Memory	Memory Words	Memory Digits	Cancellation	Word Building	Completion	Opposites	Final Rank
1	2	10	8	2.5	10	3	2.5	1	1	13	2.5	1.5	3	2
2	1	1	3.5	7.5	1	3	5.5	7	8	4	4	1.5	15	1
3	3	2	8	7.5	14.5	21.5	7	3.5	11	8	18	8.5	11.5	6
4	4	3	8	2.5	14.5	1	9	5	13.5	28	6	5.5	6	3
5	5	7	14.5	20	14.5	25.5	12.5	18.5	22	5	1	26.5	18	10
6	6.5	6	3.5	10.5	4	25.5	2.5	10.5	17	6	15	8.5	6	5
7	8	4	3.5	21	14.5	15	8	23	5	3	7	3.5	6	4
8	27	16	23	22	8	11.5	24	10.5	29.5	20	5	8.5	25	20
9	14	9	8	2.5	25.5	9	12.5	2	5	7	15	12	23	7
10	9	5	14.5	25	2	21.5	4	6	2	14	10	20	26.5	8
11	30	29	14.5	9	24	11.5	1	8.5	13.5	9	25	3.5	1	12
12	21	20	23	16	14.5	11.5	12.5	16.5	15	19	2.5	5.5	28	14
13	13	18	14.5	2.5	19	25.5	12.5	8.5	5	1	8	16	26.5	11
14	11	14	14.5	29.5	19	3	15	21	25	18	19.5	12	23	16
15	16	13	23	6	10	14	26	28	5	26.5	19.5	26.5	11.5	18
16	23	11	14.5	12	22	21.5	19.5	27	22	24	26	23	3	23
17	6.5	30	28.5	14	4	5	22	3.5	8	17	12.5	20	11.5	9
18	18	25	14.5	27	14.5	7	29	15	8	15	30	12	18	21
19	10	15	3.5	25	22	18.5	5.5	20	22	10	11	14.5	18	15
20	29	23	14.5	17	6.5	25.5	19.5	14	19	25	12.5	24	18	25
21	24	27	23	18.5	19	7	22	8.5	11	28	22	17.5	18	24
22	18	7	8	2.5	25.5	7	25	12	29.5	12	29	22	21	22
23	20	8	23	18.5	29	18.5	17.5	26	27.5	11	27	26.5	23	27
24	22	28	23	10.5	10	28	10	13	26	21.5	11	17.5	11.5	19
25	18	12	30	14	27	29	30	29	27.5	30	15	29.5	8	29
26	15	19	1	23	4	11.5	22	24	22	16	23.5	8.5	11.5	13
27	25	24	23	28	30	30	16	25	22	23	17	20	29	28
28	26	21	23	5	6.5	17	17.5	16.5	13.5	26.5	28	14.5	3	17
29	12	22	23	14	28	21.5	27	22	17	21.5	23.5	26.5	11.5	26
30	28	26	28.5	29.5	22	16	28	30	17	29	21	29.5	30	30

TABLE XVI<sub>d</sub>  
SEVENTH GRADE (VII)

RANK OF PUPILS IN THE DIFFERENT TESTS

No. of Pupil	Courtis Arith.	Woody Arith.	Handwriting	Kansas S.R.	Thorndike R.	Ayres Spelling	Logical Memory	Memory Words	Memory Digits	Cancellation	Word Building	Completion	Opposites	Final Rank
1	2	1	4	1	1.5	5.5	6	5.5	1	17	1	1	11	2
2	9.5	4	4	13	11	1	7	7	5	6	16.5	2.5	2	4
3	16	3	11.5	23	5	12	8.5	2	9	22	13	4	24.5	10
4	1	2	4	5	5	3.5	2.5	3.5	9	5	4.5	6	1	1
5	6	6	20.5	4	2.5	9.5	2.5	3.5	9	4	18.5	11.5	13	7
6	12.5	12	11.5	2	1	9.5	1	1	9	7	2	2.5	6	3
7	5	5	11.5	6	2.5	13.5	4.5	16	23.5	17	3	5	4	5
8	3	8	20.5	14.5	20	15.5	2.5	8	3.5	15	8	16	7	9
9	12.5	17	20.5	28	22.5	24	21.5	5.5	9	15	14.5	16	3	17
10	16	24	30	12	7.5	21	10	17.5	3.5	20	10.5	7	26.5	12
11	16	20	27	10	14	18	15.5	13	12.5	18	23.5	10	16	14
12	4	9	11.5	3	16	9.5	4.5	9	6	13	6	8.5	5	6
13	18.5	14	27	25	5	26	8.5	17.5	16.5	25	16.5	16	17	18
14	9.5	7	11.5	14.5	20	7	12	4	2	8	8	8.5	15	8
15	24	18	20.5	24	11	9.5	26	20	20.5	24	12	16	28	24
16	8	11	20.5	11	22.5	18	24	27	23.5	15	20	23	8.5	16
17	30	30	1	16.5	9	18	23	22	23.5	27.5	21.5	21.5	11	20
18	22	25	27	7	29	23	19	12	16.5	26	30	24	14	26
19	21	11	27	29	17.5	22	14	19	16.5	16	23.5	19.5	26.5	23
20	26	17	4	30	30	29	30	21	30	29	26	25	30	30
21	24	29	11.5	21.5	14	15.5	11	24	20.5	3	18.5	19.5	18.5	15
22	18.5	13	11.5	20	11	5	18	15	23.5	19	8	11.5	22.5	13
23	24	21	11.5	21.5	27	13.5	27	10	16.5	9	4.5	28	20.5	19
24	27	19	11.5	9	20	2	13	11	16.5	12	14.5	16	11	11
25	11	16	4	18	27	27	15.5	28	26	11	26	26.5	18.5	25
26	7	15	20.5	27	24.5	28	28.5	25.5	27	27.5	26	30	29	29
27	29	28	11.5	26	17.5	6	17	25.5	28.5	30	10.5	13	8.5	21
28	14	23	27	8	14	30	20	23	12.5	14	29	21.5	22.5	22
29	20	26	20.5	19	27	20	21.5	29	16.5	21	28	26.5	20.5	27
30	28	22	20.5	16.5	24.5	25	28.5	30	28.5	23	21.5	29	24.5	28

Tables XVI<sub>a</sub> to XVI<sub>d</sub>, inclusive, give the position each pupil holds in his grade in the tests. In addition, the tables give a final rating based upon those of the individual tests. This final rating gives the position each pupil holds with respect to the tests as a whole. This rating was secured by adding the numbers representing the position each child held in each of the tests. The sums thus secured were arranged from smallest to largest and the final rank of each pupil determined. It should be noticed that 43 individual measures contribute in the determination of the final rank of each pupil in the fourth grade and 48 in the case of the pupils in the other grades.

Table XVI<sub>a</sub> summarizes for the fourth grade the relation between achievement and teachers' judgment. An examination of the table shows that one pupil of G. 1 made a rank which would place him in G. 2, while one member of G. 2

holds second place for the whole grade and should be placed in G. 1. Three pupils in G. 3 are inferior in position to three others in G. 4. Pupil number 1, who was rated as best by the teachers, stands fifth in achievement as measured by the tests.

Table XVIb gives the position each pupil of the fifth grade secured in the tests. It is seen that there is considerable variation from the rank given by the teacher. One pupil of G. 1 makes scores such as to place him in G. 2, while two pupils of G. 2 fall in G. 3 and one of G. 3 in G. 4. Pupil 7 of G. 2 makes scores which would place him in G. 1. Likewise pupils 14 and 17 of G. 3 and pupil 21 of G. 4 make scores which would place them in higher groups.

The relative positions held in the tests by the members of the sixth grade are shown in Table XVIc. Pupils number 5, 8, and 16 are given a much lower position when measured by the tests, while pupils number 17, 26, and 28 secure much higher ranks. It is seen that pupil number 26 belongs in G. 2, while several others of G. 4 should be placed in G. 3. On the whole, it appears that the teachers were able to rate with more accuracy the better pupils of the grade.

Table XVI d presents the rank each pupil of the seventh grade achieved. Pupils number 12, 14, 21, 24, and 27 achieve much higher ranks than those given by the teachers. Likewise pupils number 3, 8, 9, 15, 18, and 20 are given much lower ratings when measured by the tests. On the whole, there is a fairly close relationship between teachers' judgment and achievement in the tests. A correlation between the two, in case of this grade, gives a positive correlation of 74.

TABLE XVII

COEFFICIENTS OF CORRELATION—EDUCATIONAL TESTS

	Courtis Arith.	Woody Arith.	Thorndike Handwriting	Kansas S. Reading	Handwriting Speed	Thorndike Reading	Ayres Spelling
Courtis Arithmetic -----		74	36	53	21	46	39
Woody Arithmetic -----	74		37	47	23	43	43
Thorndike Handwriting --	36	37		23	12	29	42
Kansas Silent Reading-----	53	47	23		07	44	52
Thorndike H. Speed -----	21	23	12	07		27	20
Thorndike Reading -----	46	43	29	44	27		47
Ayres Spelling -----	39	43	42	52	20	47	

The relation between the results of the several educational tests are summarized in Table XVII. It should be

noticed that these are the average coefficients secured from the four grades. Owing to the fact that the fourth grade did not take all the test, only three coefficients were used in a few cases in determining averages. In order to determine which of the tests holds the closest relationship to the other tests, we have added each of the columns given in the tables. The average correlation of each test with the other six tests is:

Courtis Arithmetic with the other tests	45
Woody Arithmetic with the other tests	44
Thorndike Handwriting (Legibility) with the other tests	30
Thorndike Handwriting (Speed) with the other tests	18
Kansas Silent Reading with the other tests	38
Thorndike Reading with the other tests	39
Ayres Spelling with the other tests	40

It is seen that the arithmetic tests correlate highest with the other tests. The reading and spelling tests come next, with practically equal averages. The handwriting test correlates lowest.

TABLE XVIII  
COEFFICIENTS OF CORRELATION—RAW—THE MENTAL TESTS

	Logical Memory	Memory Words	Memory Digits	Cancellation	Word Building	Completion	Opposites
Logical Memory		66	54	54	46	75	48
Memory Words	66		54	66	61	63	46
Memory Digits	54	54		38	38	52	37
Cancellation	54	66	38		42	47	40
Word Building	46	61	38	42		53	40
Completion	75	63	52	47	53		51
Opposites	48	46	37	40	40	51	

Table XVIII summarizes the relation between the results of the various mental tests. The coefficients given are the average coefficients secured from the results of the four grades. By adding each of the columns of the table and securing an average, we are able to determine the degree of relationship each of the tests bears to the other tests. The average coefficients of correlation of each of the mental tests with the other six is:

Logical Memory with the other tests	57
Rote Memory for Words with the other tests	59
Rote Memory for Digits with the other tests	42
Cancellation with the other tests	48
Word Building with the other tests	47
Completion with the other tests	60
Opposites with the other tests	44

From the several tables it is seen that here is a fairly high correlation between ability in one test and ability in the other tests—that is, the pupils who make high scores in one test tend to do well in the other tests. The same fact is true with reference to the educational tests. Pupils who excel in one subject tend to lead in the others also. If we compare ability in the mental tests with achievement in the educational tests, we find that the pupils making the best scores in the mental tend to lead in point of achievement in the educational tests.

TABLE XIX

CORRELATION BETWEEN FINAL RANK IN THE EDUCATIONAL TESTS AND  
FINAL RANK IN THE MENTAL TESTS

Fourth Grade -----	69
Fifth Grade -----	74
Sixth Grade -----	68
Seventh Grade -----	76
Average -----	72

The relation between achievement in the educational tests and ability as measured by the mental tests is presented by the coefficients above. The final rank of each pupil in the educational and mental tests was used in securing these coefficients. It should be noticed that the coefficients represent the relation between 14 individual educational measurements on one hand and 34 on the other. It is seen that there is a very decided correlation between achievement and ability as thus measured.

## PART IV

### COMPARISON OF RESULTS WITH THOSE OBTAINED BY OTHERS

One of the earliest attempts to study the relation between ability and school progress was that of Binet ('99). He made a rather intensive study of the relation of voluntary attention to class standing. Eleven pupils were used in the study. Five of these were classed as bright and six as dull. Rather simple tests were used.

Binet concludes that the difference between bright and dull pupils lies in the fact that bright pupils are able to adjust themselves to a situation more quickly than dull. He believes that this difference is greater at first than at the end—that is, the bright children respond more quickly at first, but that the dull children adapt themselves to the situation in time, only more slowly. This would imply that bright and dull pupils are farther apart at the beginning of a task than at the end.

Carmen ('99) measured 576 pupils in the public schools of Saginaw, Mich., with reference to strength of grip and least sensibility to pain. These pupils ranged from 10 to 14 years of age. First, the names of the bright and the dull pupils were secured from the teachers. These were placed into two groups—one good and one poor. The bright pupils had a greater strength of grip except in the case of the left hand for the boys. Here the dull group seemed to be superior. Since the bright and dull pupils were not separated according to age, too much weight cannot be attached to the results; for Carmen found that sensibility to pain decreased with age, and, of course, strength increases with age.

Smedley ('00) compared the standing in school of twelve-year-old pupils scattered through the grades of the Chicago public schools with respect to motor performance. He found that the twelve-year-old pupils of the higher grades were decidedly superior in stature, weight, strength of grip, endurance, and vital capacity to those found in the lower grades. His results show that on the average the bright pupils are superior physically to the dull ones.

Gesell ('05) studied handwriting as related to school intelligence. He secured a large number of handwriting specimens. These specimens were divided into four groups, as follows:

Group I. Specimens from the three best writers in the grade.



Group II. Specimens from the three poorest writers in the grade.

Group III. Specimens from the three pupils of the highest mental ability in each grade as represented by school standing.

Group IV. Specimens from the three pupils of the lowest mentality in each grade as represented by the class standing.

The pupils in these groups were rated as to school intelligence, general intelligence, motor ability, and facility in writing. Gesell concludes that for a large number of children handwriting varies directly with school ability.

Bolton ('03) studied the relation of motor power to intelligence. He used as his subjects 120 children in the public schools of Lincoln, Neb. Sixty of these children came from the best homes of the city and sixty came from the poorer districts. He characterized these two groups as his good and poor groups. Notwithstanding the fact that he selected the children so as to have equal age groups, the good group averaged two grades higher than the poor. Tests of voluntary control (the tapping test), steadiness in standing, and steadiness and precision in moving either hand were used.

The good children surpassed the poor in every trial. Not only were the good children superior, but this superiority seems to increase with age. The gap between the good and poor nine-year-old children was much wider than that between the good and poor eight-year-old ones. Bolton concludes that, with bright children, motor power increases with age. He says: "There is greater rapidity of motion, increased steadiness, and nicer precision the older the children grow. Backwardness, slowness of growth, and arrest of development are indicated by pupils through their inferiority to their fellows of the same age." While all these tendencies are noticeable, probably the most striking fact is the amount of fluctuation shown by the poor children.

Terman ('06) has attempted to differentiate bright pupils from dull by studying the ability of fourteen boys at "eight more or less different points"—namely, (1) their powers of creative imagination or invention, as tested by the ability to solve puzzles; (2) their logical processes; (3) their mathematical ability, as tested by the ability to solve arithmetical problems requiring original thinking; (4) language ability, as tested by spelling, word building, reading, completion tests, and ease in interpreting oral commands; (5) their insight as revealed in the interpretation of fables; (6) rapidity in learning, as revealed in learning the game of chess; (7) memory abilities, as shown

by memory for geometrical forms, moves in chess, steps in the solution of puzzles, and for connected ideas; and (8) their motor ability, both general and in the acquisition of new forms of behavior. He used a great many and varied tests, but in the main they formed a connected group.

The subjects selected were considered by their teachers as among the brightest or dullest boys that could be found in the city of Worcester. Seven bright and seven dull boys were used in all the tests.

It is very hard to evaluate with any degree of accuracy the records made by the subjects. Specific comparisons cannot be made, owing to the fact that the number of subjects was very small, that the tests used were new, and that few of the tests used have since been standardized. Again, "bright" and "dull" are only relative terms and give us no notion as to the comparative standing of the two groups with reference to school intelligence. Subject to these limitations, however, Terman found that most of his tests did clearly differentiate between the bright and dull boys.

Terman concludes that the bright group of boys is superior to the poor group in all the mental tests, but inferior in the motor tests. This superiority of the good group seems to be about the same in all the mental tests except those falling under the head of invention, where there seems to be only slight differences. The superiority of the dull group of boys over the bright group in the motor tests seems to be hardly characteristic of people in general. If so, it means that there is a negative correlation between intellectual and motor ability. This seems to be in conflict with the results secured by other investigators. Smedley ('00), Bolton ('03), and others have found that "good" children were superior to "poor" children in motor ability.

Bonser ('10) made a very extensive study of the capacity of grammar-school children for those forms of thinking which are commonly called "reasoning." His subjects were 757 children of the fourth, fifth, and sixth grades of the public schools of Passaic, N. J. He used a series of tests which he thought would exercise four of the most fundamental phases of purposive thinking—namely, the mathematical judgment, controlled association, selective judgment, and that complex process used in the interpretation of literature. Bonser felt that the tests really subjected the pupils to nearly all forms of purposive thinking. He says: "These pupils have been subjected to various forms of each of the four types of reaction which furnish a measure for four somewhat overlapping and related, though quite complex, forms of purposive thinking. It is

believed that measures of these qualities, properly related, will provide fairly reliable measures of what we usually mean by reasoning ability."

Bonser wishes to show that within the grades the younger pupils were equal to or exceeded older ones in median ability, and his results seem to bear him out in this conclusion. In 24 cases out of 36 the youngest 25 per cent of the pupils in the grade equaled or surpassed the median ability of the oldest 25 per cent. In 27 cases out of 36 the median ability of the youngest 25 per cent of the pupils equaled or surpassed the median ability of the whole grade. Bonser's results show clearly that there are two well-defined groups in every large grade—first, those who for various reasons are retarded, and, second, those who are accelerated or more advanced in mental ability. Furthermore, this accelerated younger group seems to surpass the retarded older group in ability and to equal at least the median ability of the whole grade.

A further interesting fact is shown by Bonser's results. In studying the youngest and oldest groups, comparison is made between groups of unequal ages. When groups having the same median age, but of different grades, are compared, the same results are found as when the youngest and oldest groups within the same grade are compared—that is, the youngest group in each grade surpasses in median ability the whole group immediately lower, but having approximately the same age.

Lapie ('12) studied several groups of children. He found in every class a small number of children who were advanced for their age and also a small number who were retarded. From these two groups he selected 24 pupils—23 boys and 1 girl—for his study. The advanced ones ranged from 8 years and 6 months of age to 11 years; the retarded, from 12 to 14. These two groups were further divided into subgroups—A2, A1, R1, and R2. The A2 group contained all the pupils accelerated by more than two years, the A1 group contained all those accelerated a year or less, the R1 group contained all those retarded a year or less, and the R2 group contained all those retarded more than one year. Six pupils were placed in the A2 group, 7 in the A1 group, 5 in the R1 group, and 6 in the R2 group.

The most unfavorable element connected with the experiment was the age difference. It is practically certain that the results are not what they would have been had equal age groups have selected. The results secured from most, if not all, mental and physical tests are affected by the age factor. It should be noted, however, that the age differ-

ences were so distributed as to give the advantage to the duller group. The differences brought out by the mental tests have more significance because of this age difference.

Lapie says that the advanced groups not only respond more rapidly, but that their ideas have more logical connections than do those of the retarded group. "The retarded seemed to digress from the train of thought more than the accelerated. Their attention could not be kept on a single line of thought, but was constantly shifting from one external perception to another." The accelerated pupils not only had a greater number of associations, but the most marked difference between the groups was in respect to the types of associations. Associations due to the similarity in appearance or sound of two words were more frequent with the retarded groups, while associations due to logical connections were more frequent with the accelerated groups. The retarded groups frequently responded to a stimulus word by naming some object present to the senses. The accelerated groups seemed to be more able to hold their attention on the problem in hand and to respond with ideas having some logical connection with the stimulus word.

As a further study, Lapie examined the physical conditions of the children and the economic and social conditions of their homes. Taking into account all the differences in development due to differences in age, he believes that the advanced pupils are developed better for their ages than the retarded for theirs. This difference, he explains, may be due to the fact that the advanced pupils were well nourished, while the retarded pupils came from homes not in good economic circumstances. In his study of the home conditions, he found that one pupil from group A2 came from a home of just moderate economic circumstances. The other members of the group were the children of teachers or merchants. Here he found small families, no family having more than two children. The parents of the A1 group were of slightly less economic independence. The majority were small merchants or employees of the railroad. The number of children in these homes ranged from two to five. In the homes of the R1 group the economic conditions were worse and the families larger, the number of children ranging from five to nine. Although the parents of this group had larger families, their revenues were smaller. Poverty was found to rule in the families of the R2 group. Here alcoholism had consumed a good part of the total family revenue. Large families with a high death rate and poor economic and social conditions characterized the homes from which the retarded groups came. Small

families, a low death rate, and good economic and social conditions were characteristic of the homes from which the accelerated pupils came.

By way of summary, Lapie says that the study seems to point out the fact that accelerated pupils are of superior ability at every point. Moreover, he believes that this superior mental ability is accompanied by or has its foundations in a vigorous physical condition. Furthermore, he found that mental and physical superiority usually went along with good economic, social, and moral conditions.

Lapie is correct in that inferior physical and mental abilities are generally found where poor economic, social, and moral conditions prevail. But the inference that these inferior abilities are the result of poor economic, social, and moral conditions is hardly justifiable, to say the least. Inferior mental and physical abilities, poor economic, social, and moral conditions, are more likely the result of poor hereditary equipment.

Keys ('11) made a rather extensive survey in his attempt to locate accelerates and arrests in the grades. He estimated that one-fourth of all the pupils in our grades were potential accelerates. He believes that deportment, the absence of physical defects or superior physical ability, and regular attendance, all play an important rôle in success in school work. Keys was unable to determine how far conduct influenced the teacher in grading on school subjects and how far good school work influenced the teacher in rating the pupils in conduct. He believes that they mutually influence each other. The conduct rankings would seem to be a fairly good index as to how far the pupils fit into the spirit of the work. It is very likely true that children whose conduct is good are freed from many irrelevant things that hinder progress in the grades. Keys found that the accelerated pupils received higher conduct grades than any other class except the honor class.

Winch ('06) studied the relations existing between "rote" memory and proficiency in school subjects. He selected 6 girls from the upper half and 6 from the lower half of the same grade. There were 65 girls in the grade. He used ten sets of consonants as the memory material. He lays stress on the suggestion that general intellectual proficiency is usually accompanied by good memory. It appears that the only girl among his subjects in the upper section with a low memory score is much older than the other girls in that section. In the lower section there is, however, one subject (D. R.) whose good memory score is not accompanied by high position in class. Winch concludes as follows:

(1) That pure memory improves with age within the limits chosen, but principally in so far as increased age itself implies increase of general intellectual proficiency; and (2) that there is generally a direct relation between "good memory" of this kind and intellectual proficiency, so far as this can be measured by success in school subjects.

Kelley ('14) investigated the records of 59 grammar-school students who had passed on to the high school. He found the coefficient of correlation between the first-year standing in high school and the average grades received in the fourth grade to be 62. This, together with the fact that some of the pupils had skipped grades, led him to say that there is strong evidence that natural capacity is a very much more important factor than training in determining relative scholastic standing. In fact, he found the correlation between an estimate of the pupil's ability to do high-school work made when the pupil is in the fourth grade to be nearly as accurate as one made when the pupil is in the seventh grade. This leads one to feel that it is very important that an adequate record of each grammar-school pupil's ability and attainment be kept.

Terman ('15) studied the relation of school success to intelligence. His data were by-products of the study of the school success of 1,000 nonselected school children who were tested in 1914-1915 by the Stanford Revision of the Binet-Simon measuring scale of intelligence. The study deals principally with the correlation between the intelligence quotient and grade progress. No child with a mental age below 8 was included in the study.

Terman found a rather surprising disagreement between grade progress and mental age. Of the 1,000 children, 85 were retarded two or more grades below the norm for their mental age. Of the 85, 23 per cent were actually accelerated by chronological age. Only 8 per cent of those who were retarded two years or more according to mental age were retarded as much as two years by chronological age. Comparison of grade status with mental age and chronological age revealed the fact that the grade location of children does not fit their mental age much better than their chronological age.

To summarize, Terman found:

1. That the range of distribution over the grades by mental age, although less than by chronological age, was very great.
2. That, compared to his possibilities, the child of exceptionally superior intelligence is almost always retarded, because teachers are prone to promote by chronological age

rather than mental. His work is nearly always superior, and the evidence suggests strongly that this superiority of school work would continue even if extra promotions were granted.

Wallin ('11) studied the relation of spelling efficiency to sex and age. In the Cleveland schools he found the girls to be more proficient than the boys. The difference between the gross averages for all the schools amounted to 2.1 per cent. He concludes that the girls' superiority is mostly on the side of verbal memory.

He compared the normal pupils with the accelerated and retarded with respect to proficiency in spelling. The accelerated pupils, although younger than the normal, surpassed them in spelling ability. Likewise the retarded pupils, although older than the other members of the grade, were the least efficient.

Mead ('16) studied the relation of intelligence to certain mental and physical traits. His data were secured from measurements taken of 430 feeble-minded children and 480 normal children. The following relations were studied: (1) Age of walking and talking in relation to general intelligence, (2) the height and weight of the children in relation to general intelligence, (3) strength of grip and dexterity in relation to general intelligence, (4) perception and memory in relation to general intelligence.

He summarizes his study by saying that normal children are better at each age studied than mentally defective children. Sexes differ less with the feeble-minded. "Defective children occupy the lower end of a large distribution curve for children in general." The best mental powers which defective children are likely to bring to school are those of perception and memory.

Pintner ('18) has done an exceedingly valuable piece of work in devising norms by which a mental survey may be made. During his preliminary work in establishing norms, the children in a number of schools were tested. Great variability of the mental index in the different grades of the same school was found. A mental index of 58.5 was found for one school, while an index of only 17 was found for another.

## PART V

### SUMMARY AND CONCLUSIONS

A. *As to Procedure.*—In this study, four grades, composed of 108 pupils, have been studied rather intensively. The grades selected for the study are undoubtedly much above the average both in point of organization and instruction. Each grade has been arbitrarily divided into four groups according to the teachers' estimate of the ability of the pupils. The groups of each grade are composed of approximately the same number of children, and there are but slight age differences between the groups of any grade.

Fourteen educational and thirty-four mental measurements were taken of the grades. The results have been given both in their original and final form. Thus any calculations may be checked or the data rescored in any manner desired.

The following relations and comparisons have been studied:

1. A comparison of the achievement of the brighter or duller pupils of the grade with the grade as a whole.

2. A comparison of the brighter or duller pupils of a grade with a similar group in another grade.

3. A comparison of the achievement of any group within a grade with the achievement of the four grades combined.

4. The relation between accomplishment and accuracy.

5. The relation between accomplishment in the tests and school standing.

6. The relation between teachers' judgment and accomplishment.

7. The relation ability in one test bears to ability in the other tests.

B. *As to Results.*—In general, we have found it highly instructive to compare the achievement of the better or poorer pupils of a grade with each other or with the grade as a whole. The better pupils of a grade frequently, as in the arithmetic or logical memory tests, do from 50 to 100 per cent better than the poorer members of the same grade. Frequently the brighter pupils of a grade surpass the average attainment of the whole grade by 50 per cent.

There is considerable overlapping of ability between grades. Children with ability equal to the median ability of the grade above are found in all our grades. Pupils of



exceptional ability in a lower grade often surpass the poorest 25 per cent of the pupils of several grades above.

A close correlation between accomplishment, as measured by the tests, and accuracy, in terms of errors made, exists—that is, a high degree of attainment has a tendency to be accompanied with a like degree of accuracy. The better pupils of a grade not only work faster, but also work more accurately. In case of a function, as addition, which operates in the daily school life of the pupils, it appears that the relation between accuracy and attainment is very close. This is probably due to the fact that previous practice has emphasized accuracy.

A close relation exists between ability as measured by the tests and progress in the grades. A coefficient of 72 was found between attainment in the educational tests and school standing, and one of 68 between ability as measured by the mental tests and school standing.

Pupils who display exceptional ability in one test tend to do well in all the tests. A correlation of achievement in the educational tests with ability displayed in the mental tests, gives a coefficient of 72. In studying the school record of the children, the writer was impressed with the fact that a pupil standing near the top in one school subject tended to rank high in the other subjects also.

The data presented suggest that the brighter pupils of a grade are able to do much more work than the duller pupils of the grade. The fact that the members of a grade differ in their hereditary equipment, that some members are able to do twice as much work as others, has considerable importance for the school. It is evident that pupils with different degrees of ability cannot receive the same instruction and yet progress at the same rate. No grade can be taught as a whole and its members progress at an even rate.

If the pace for the grade is determined by the ability of the better pupils to progress, the result is that the duller pupils are given tasks which they are unable to accomplish. They consequently fall farther behind, repeat the grade, or drop out of school. If the pace is set by the duller pupils of the grade, the better pupils are not compelled to put forth their best efforts, and consequently fall into habits of inefficiency.

There is probably little danger of overwork. The poorer pupil is in more danger of having the grade progress so fast that he is unable to understand and do the tasks set for him, while the better pupil is in danger of not having enough tasks set for him and consequently of falling into apathy and habits of inefficiency.

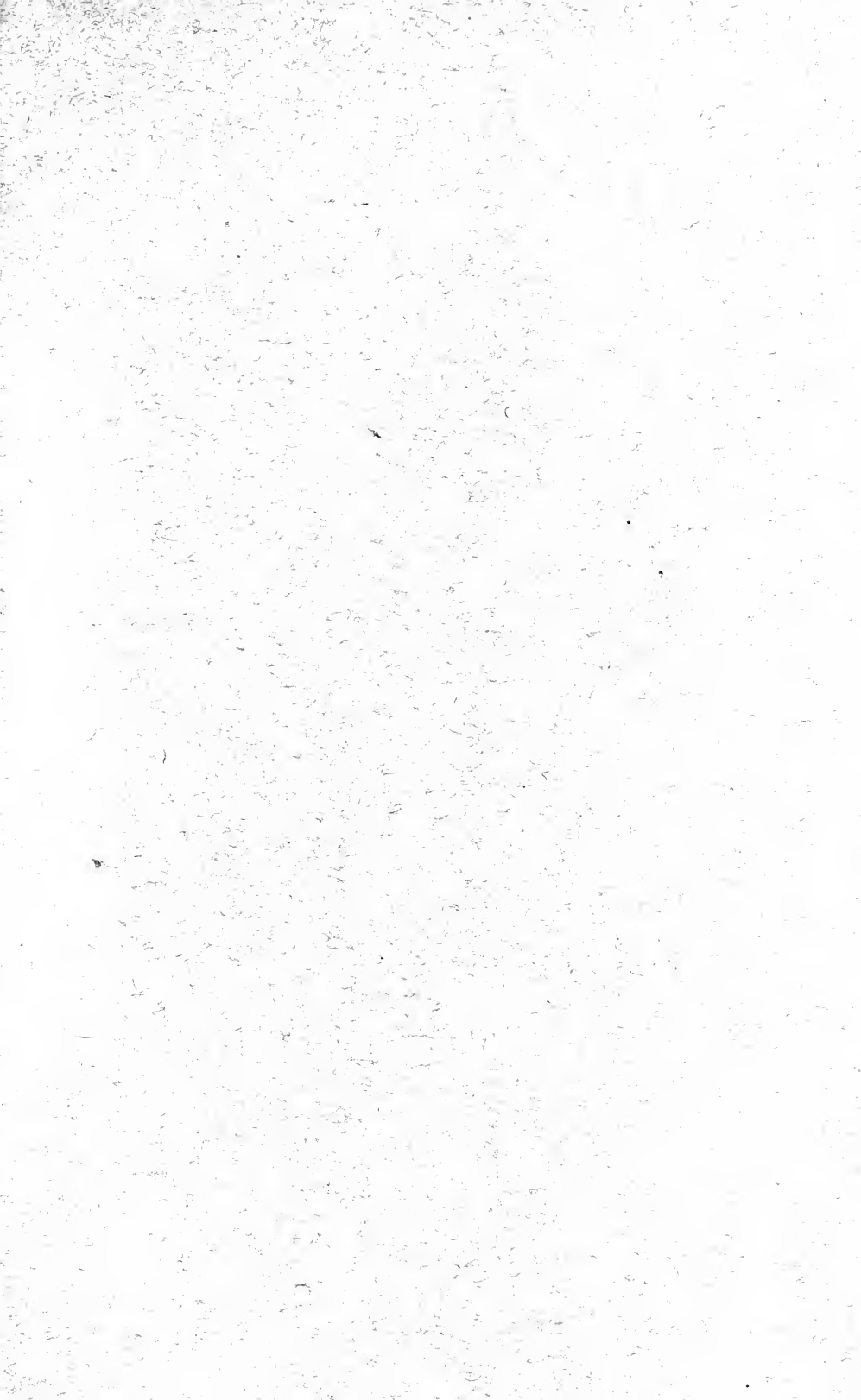
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